A Framework for Assessing the Reusability of Hardware (Reusable Rocket Engines)

Within the space flight community, reusability has taken center stage as the new buzzword. In order for reusable hardware to be competitive with its expendable counterpart, two major elements must be closely scrutinized. First, recovery and refurbishment costs must be lower than the development and acquisition costs. Additionally, the reliability for reused hardware must remain the same (or nearly the same) as “first use” hardware. Therefore, it is imperative that a systematic approach be established to enhance the development of reusable systems. However, before the decision can be made on whether it is more beneficial to reuse hardware or to replace it, the parameters that are needed to deem hardware worthy of reuse must be identified. For reusable hardware to be successful, the factors that must be considered are reliability (integrity, life, number of uses), operability (maintenance, accessibility), and cost (procurement, retrieval, refurbishment). These three factors are essential to the successful implementation of reusability while enabling the ability to meet performance goals. Past and present strategies and attempts at reuse within the space industry will be examined to identify important attributes of reusability that can be used to evaluate hardware when contemplating reusable versus expendable options.

This paper will examine why reuse must be stated as an initial requirement rather than included as an afterthought in the final design. Late in the process, changes in the overall objective/purpose of components typically have adverse effects that potentially negate the benefits. A methodology for assessing the viability of reusing hardware will be presented by using the Space Shuttle Main Engine (SSME) to validate the approach. Because reliability, operability, and costs are key drivers in making this critical decision, they will be used to assess requirements for reuse as applied to components of the SSME.